DOCUMENT RESUME

ED 097 623 CS 001 355

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TITLE Attention to Stimulus Presentation Mode as Related to Sex.
PUB DATE Sep 74
NOTE 16p.; Paper presented at the Annual Meeting of the American Psychological Association (82nd, New Orleans, Louisiana, Aug. 30-Sept. 3, 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Aural Stimuli; Elementary School Students; *Learning Processes; Reading Instruction; *Reading Research; *Sex Differences; *Visual Stimuli

ABSTRACT

This study examines attention to stimulus presentation mode (SPM) by children when subdivided by age and sex, and the interaction between these variables. Except for the crossover period, female and male subjects' responses to auditory and visual stimuli follow the same general pattern; younger subjects respond at a greater rate to visual stimuli. Additional research also shows that subjects' sex provides a significant interaction with age during the crossover period. Even though this study did not attempt to assign a cause to the crossover phenomena, there are several possibilities. The crossover ages are approximately those of puberty, so the possibility of maturational process exists. It is also possible that as reading level increases attention shifts to the visual mode, and the sex difference could be related to the earlier reading behavior of females. There could also be some sociocultural factors. (SW)

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ED 097623

ATTENTION TO STIMULUS PRESENTATION MODE AS RELATED TO SEX

Presented to

EIGHTY-SECOND ANNUAL CONVENTION

of the

AMERICAN PSYCHOLOGICAL ASSOCIATION

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Learning is a basic process of life. It is generally agreed that learning is initiated by stimuli of one type or another, and, for formal, classroom learning, our educational institutions have been delegated the task of selecting stimuli and arranging them systematically in order to encourage learning of some specific subject matter. The stimuli selected by our institutions are almost invariably those which can be presented to the learner by auditory or visual methods, which are both quite effective: the bulk of our interpersonal and public communication is transmitted and received in these modes. There is, however, a difference in the relative effectiveness of auditory and visual presentation modes. Several studies of learning and retention, including Young (1936), Corterette (1967), Stevenson (1969), Rardhana (1971), and Perelle (1972) have shown the auditory stimulus presentation mode (SPM) to be superior to the visual SPM for younger children, those below approximately age 11, and the visual presentation mode to be superior to the auditory over age 13. Recently attention has been considered the critical variable in presentation mode effectiveness; the link between stimulus and behavior (Perelle, 1974).

There is very little agreement about the exact nature of attention. It has been thought to be a filter by Broadbent (1958), a selective filter operating prior to short term memory by Treisman (1969), an orienting response by Mustofsky (1970), and a basic behavior form by Staats (1968). Although the mechanism of attention may be subject to controversy, there is no doubt of the importance of attention to the learning process. The stimulus that is attended is the stimulus that can elicit a response and, in a learning environment, attention can

make the probability of the desired responses, learning, high, while making the probability of undesired responses low.

In a typical classroom, as in most other areas of human activity, there is competition for attention, not only among stimuli in the same presentation mode but also between different presentation modes. For a learning stimulus to be effective, therefore, attention must be directed first to the mode of presentation, auditory or visual, and then to the stimulus itself. The process may be considered a behavior chain in which response to the SPM is attention to that SPM, which then allows attention to the stimulus, which may then elicit the desired learning response. No matter how brilliant may be the instructor's visual presentation on the chalkboard, if the student is attending the auditory stimulus presentation mode he will learn nothing from the instructor's visually presented material.

Investigation of attention to SPM has shown the existence of a crossover phenomenon at age 12.5. In a prior analysis, we examined subjects, age 7 through age 17, and found highly significant age related differences between subjects: younger subjects responded to stimuli presented in the same auditory mode at a much higher rate than to stimuli presented in the visual written mode, and older subjects reversed the presentation mode preference.

This study examined attention to SPM by children when subdivided by age and sex, and the interaction between these variables. The two common modes of classroom presentation, auditory and visual, were investigated with the experimental stimuli kept simple to compensate for the lower reading ability of the younger subjects.

Method

1083 students, almost the entire student population of a small suburban school district in New York State, were the subjects (Ss) for this study. This population included approximately 90 Ss from each of grades 2 through 12. The subjects were randomly divided into 2 control groups and an experimental group by age.

Three versions of a black and white, sound, motion picture film, of 7½ minutes duration were used to present the stimuli for this research. The two control versions and one experimental version were prepared specifically for this stud with a story line written around a central social theme, selected to provide involvement for the reference population.

The stimuli contained in the experimental version of the film were a series of conflicting information bits, or dichotomous stimuli. For example: the central character found and picked up a wallet. The camera panned to the wallet and then cut to a rapid, extremely short, close-up of money in the wallet showing a $10.00 bill. At the exact instant of the close-up of the visual stimulus of the $10.00 bill, the central character said aloud, "Twenty dollars". The auditory stimulus of "twenty" was presented at the exact moment the visual stimulus, the short close-up of the $10.00 bill, occurs. The visual stimulus duration was exactly equal to the auditory stimulus duration. There were 19 such dichotomous stimuli in the film.

The auditory and visual control films were identical to the experimental film with the exception of the elimination of visual or auditory conflicting information bits. All other auditory and visual information remained in tact.

In order to assure that all subjects were provided with the same introduction and the same instructions, an announcer was filmed prior to the action of the film to provide an introduction, and after the action of the film, to provide instructions for completing the test instrument booklets. The subjects were instructed to answer all questions and, if they were uncertain of the answer, to guess. The test booklet consisted of 19 multiple choice questions with three response choices, one corresponding to the auditory stimulus, one to the visual stimulus and one distractor and also contained questions to obtain categorizing information, such age and grade. Six questions elliciting non-experimental information were included with general questions to partially disguise the real purpose of the test.

The two control groups provided both a base measure and content validity for the test instrument. Their answers to each question were analysed to determine that at least 50% of each control group answered each question correctly, i.e.: picked the spoken stimulus if they were in the auditory control group or the written stimulus if they were in the visual control group. If at least 50% of both groups did not answer a question correctly, it was assumed that the question was inappropirate, ot the stimulus did not cuase learning, and the question was eliminated.

Results

Figures 1 and 2 illustrate the response to SPM as a function of age for female Ss and male Ss respectively. It can be observed that the crossover phenomenon takes place at age 11.5 for females and age 13.5 for males. Below the crossover age auditory stimuli elicited response at a significantly greater rate than visual stimuli ($P < .001$)

and above the crossover age, visual stimuli elicited response at a significantly greater rate than auditory stimuli ($P < .001$). Tables 1 and 2 provide supplemental information for Figures 1 and 2 and, in addition, provide *t* ratios for the differences between auditory and visual response means. It can be seen that at all ages except at the crossover period, *t* ratios show a significant difference ($P < .001$).

Figures 3 and 4 show the auditory response means for female and male Ss and the visual response means for female and male Ss respectively at the crossover ages. Tables 3 and 4 provide data and *t* ratios for the response means shown. It can be seen that from age 11 to age 14, which is ½ year prior to the female crossover age to ½ year after the male crossover age, there is a significant difference between the auditory and visual response means of female and male Ss ($P < .05$). These results provide an indication that attention to SPM is related to sex as well as age.

Conclusions

Perelle (1974) found that auditory stimuli are attended at a significantly greater rate than visual stimuli by Ss below age 12.5. It can be seen in Figures 3 and 4 that, except for the crossover period, female and male Ss' response to auditory and visual stimuli follow the same general pattern: younger Ss respond at a greater rate to visual stimuli. This additional research has shown that Ss' sex provides a significant interaction with age during the crossover period.

This study did not attempt to assign a cause to the crossover phenomena, but there are several possibilities. The crossover ages are approximately those of puberty so the possibility of maturational process exists. It is also possible that as reading level increases attention

shifts to the visual mode, and the sex difference could be related to the earlier reading behavior of females. There could also be some socio-cultural factors. If educational research determines visual attending behavior is required for efficient learning at younger as well as older school ages, visual training methods should be developed but if research ultimately shows that visual attention is a function of physiological maturation, changes should be made in elementary school teaching techniques. In any event, further research is suggested with a truncated age range, age 10 to age 15, and an investigation of individual differences in crossover age as correlated with other variables.

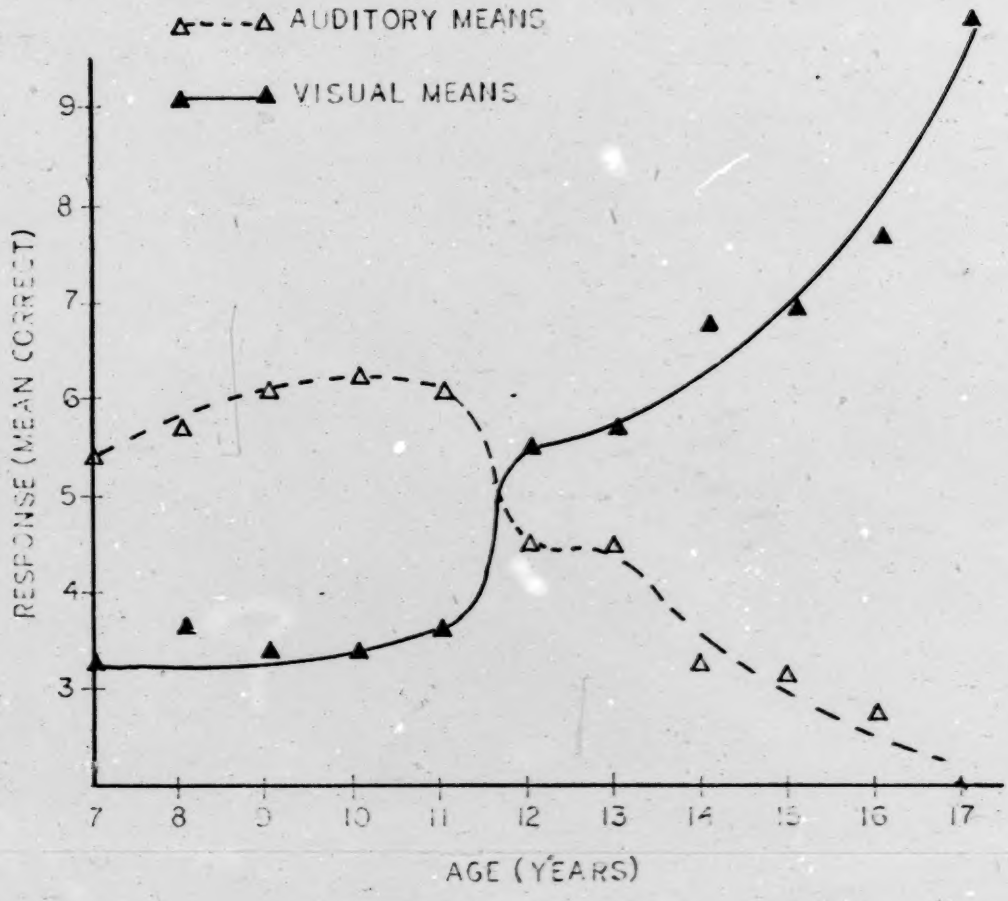

Fig. 1. Female Ss: Age versus mean response

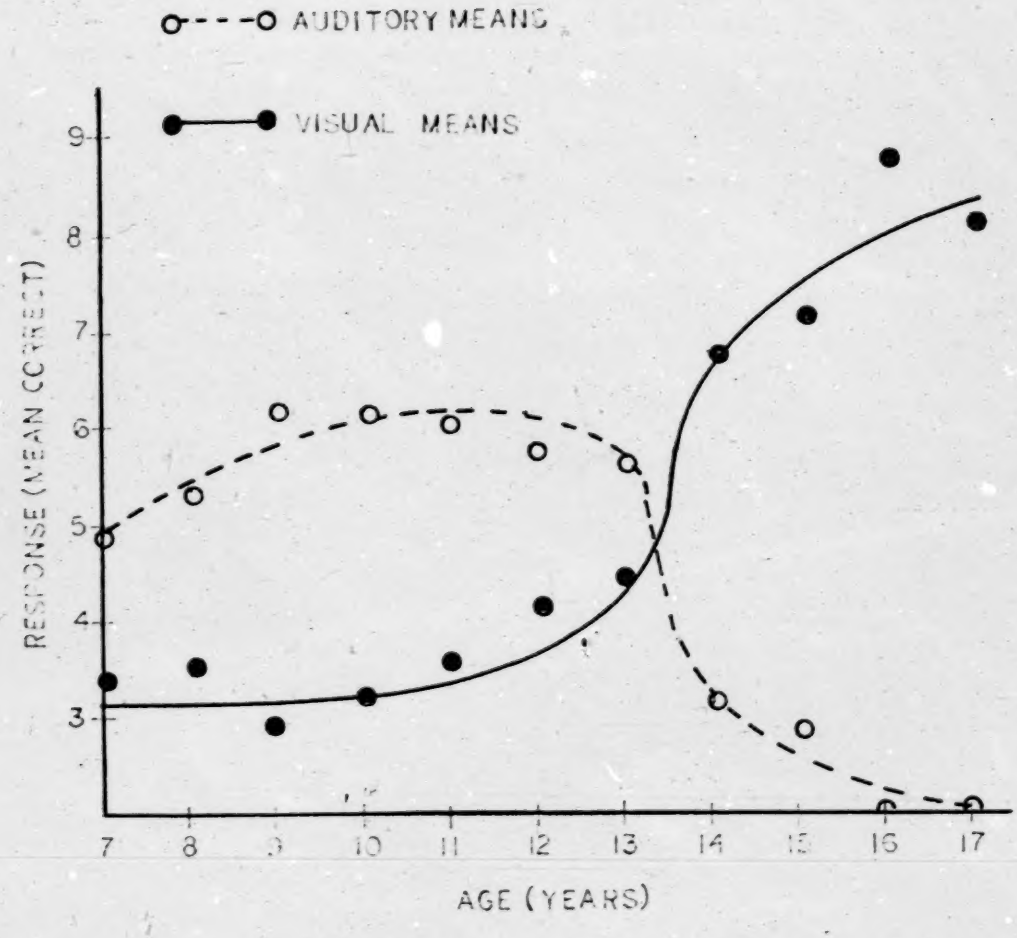

Fig. 2. Male Ss: Age versus mean response

Table 1

Experimental Group Female Ss' Response Means, Standard Deviations, and t Ratios

Age	Auditory Mean	Visual Mean	Auditory S.D.	Visual S. D.	t
7	5.4	3.2	1.7	1.4	4.69**
8	5.6	3.7	1.5	1.4	4.63**
9	6.1	3.3	1.7	1.7	6.79**
10	6.3	3.3	1.7	1.7	6.25**
11	6.1	3.5	1.5	1.7	6.68**
12	4.6	5.5	1.8	1.6	-1.97
13	4.6	5.7	0.8	0.7	-2.53*
14	3.3	6.9	1.3	1.1	-5.15**
15	3.2	7.0	2.7	3.2	-5.14**
16	2.8	7.8	2.6	2.7	-4.42**
17	0.5	10.1	0.7	0.7	-9.69**

*P < .05
**P < .001

Table 2

Experimental Group Male Ss' Response Means, Standard Deviations, and t Ratios

Age	Auditory Mean	Visual Mean	Auditory S.D.	Visual S.D.	t
7	4.9	3.5	1.7	1.5	2.83**
8	5.4	3.7	2.0	1.6	2.57*
9	6.4	2.9	2.1	1.8	7.16***
10	6.3	3.2	1.7	1.8	7.29***
11	6.0	3.6	1.6	1.5	5.58***
12	5.8	4.2	1.9	1.8	2.99**
13	5.7	4.5	0.6	0.5	1.89
14	3.1	6.8	0.9	1.2	-6.98***
15	2.8	7.2	2.1	2.6	-5.47***
16	1.8	9.0	0.4	0.6	-19.37***
17	2.4	8.0	2.0	2.1	-6.08***

*P < .05
**P < .01
***P < .001

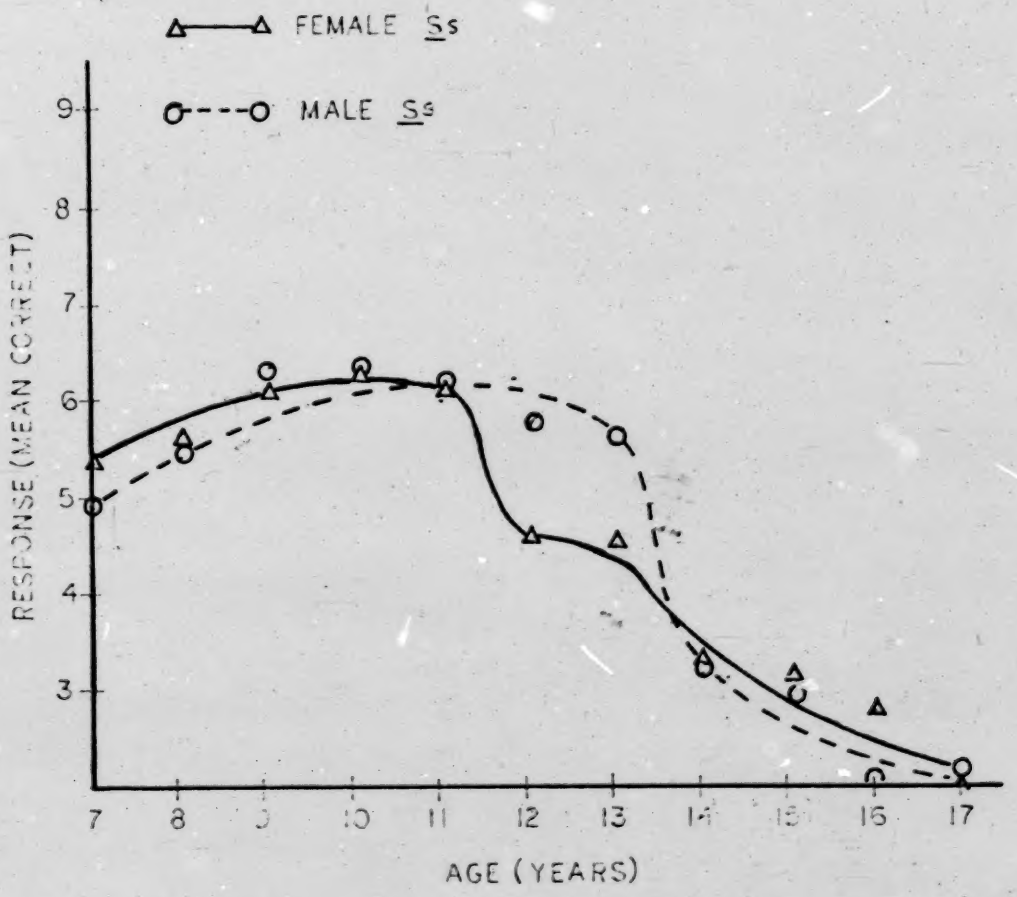

Fig. 3. Female and Male Ss: Age versus Auditory Response Score Means

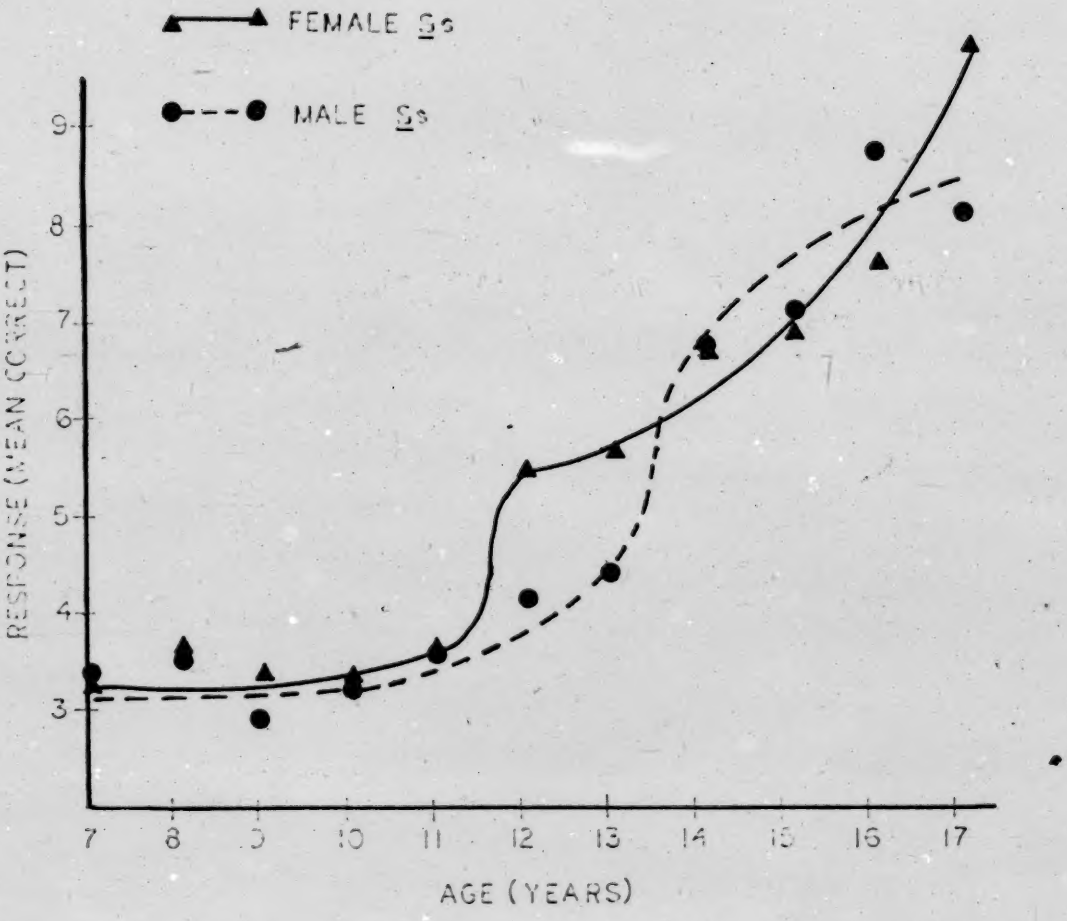

Fig. 4. Female and Male Ss: Age versus Visual Response Score Means

Table 3

Experimental Group Male and Female Ss' Auditory Response Means, Standard Deviations, and t Ratios

e	Male Ss Auditory Mean	Female Ss Auditory Mean	Male Ss Standard Dev.	Female Ss Standard Dev.	t
	6.0	6.1	1.6	1.5	0.25
	5.8	4.6	1.9	1.8	2.33*
	5.7	4.6	0.6	0.8	2.48*
	3.1	3.3	0.9	1.3	0.37

* $P < .05$

Table 4

Experimental Group Male and Female Ss' Visual Response Means, Standard Deviations, and t Ratios

Age	Male Ss Visual Mean	Female Ss Visual Mean	Male Ss Standard Dev.	Female Ss Standard Dev.	t
11	3.6	3.5	1.5	1.7	0.24
12	4.2	5.5	1.8	1.6	2.74*
13	4.5	5.7	0.5	0.7	3.16*
14	6.8	6.9	1.2	1.1	0.18

*P < .05

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